SCIENCE 14

MODULE 5: MIXING AND MEASURING

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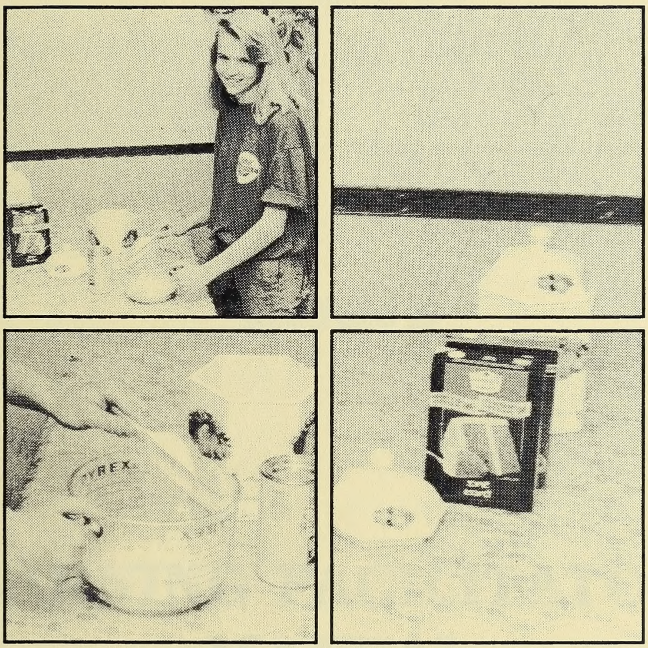

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Learning Facilitator's Manual

Distance Learning

Alberta EDUCATION

Science 14

Module 5

LEARNING FACILITATOR'S MANUAL

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Note

This Science Learning Facilitator's Manual contains answers to teacher-assessed assignments; therefore, it should be kept secure by the teacher. Students should not have access to these assignments until they are assigned in a supervised situation. The answers should be stored securely by the teacher at all times.

Science 14
Learning Facilitator's Manual
Module 5
Mixing and Measuring
Alberta Distance Learning Centre
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Module 5 – Mixing and Measuring: Overview

The emphasis of this module is to have students view the household from a scientific point of view. The student will make measurements and observations of common household items. All households are continually making use of science terminology, scientific principles, and scientific methods which can be seen as unscientific only because the activities are not carried out in a science lab. The student should learn to view the daily activities and substances of a household as scientific activities and substances.

MIXING AND MEASURING

Section 1: How Big Is It?
- measurements occurring in a household

Section 2: Mixing it Up
- types of mixtures found in a home

Section 3: Solubility
- measuring and recording observations involving solutions

Section 4: Suspensions
- producing suspensions
- separating components in suspensions

Materials You Need

The following is a list of materials necessary to complete the investigations in Module 5.

Section 1: Activity 1

- metric ruler or metric tape measure

Section 1: Activity 2

- 500 mL measuring cup
- five different household cups
- four different drink cans or bottles
- a 2 L milk carton

Section 1: Activity 3

- bathroom scale
- small kitchen scale (optional)

Section 1: Activity 4

- thermometers (optional)

Section 2: Activity 3

- measuring spoons
- test tube
- rubber stopper
- baking soda
- powdered soap
- rubbing alcohol (methyl hydrate)
- turpentine (or paint thinner)
- sugar
- flour
- butter
- cooking oil
- salt
- vinegar
- soil
- cornstarch
- instant coffee

Section 2: Enrichment

- sugar
- salt
- two polystyrene cups
- grease pencil (or masking tape)
- two stirrers
- beaker or pan
- stove or hotplate
- thermometer
- measuring spoons (or graduated cylinder or balance)
- crushed ice and water

Section 3: Activity 1

- measuring spoons (or graduated cylinder)
- test tube
- salt
- butter
- powdered soap
- rubbing alcohol
- water
- sugar
- cooking oil
- turpentine (paint thinner)

Section 3: Activity 2

- measuring spoons (graduated cylinder)
- three test tubes
- rubber stopper
- test tube clamp
- small pan
- 15 mL sugar
- grease pencil (or masking tape)
- 1/4 of an Alka-Seltzer tablet
- crushed ice
- wide mouth glass or beaker

Section 3: Activity 3

- 10 g alum (12 mL)
- 10 g salt (8 mL)
- 10 g sugar (12 mL)
- measuring spoons or graduated cylinder
- four small jars

- grease pencil (or masking tape)
- thermometer
- three small stirring spoons
- 30 mL sugar
- 100 mL beaker or small pan
- Popsicle™ stick
- safety goggles
- candy thermometer (optional)

Section 3: Enrichment

- 30 mL alum
- clean glass jar or beaker
- fine white thread (or thin fishing line)
- pencil
- pot

Section 4: Activity 1

- 10 mL soil
- two jars with lids
- paper coffee filter (or paper towel)

Section 4: Activity 2

- cooking oil
- liquid soap
- test tube

Section 4: Enrichment

- 5 mL instant coffee
- a tea bag
- an orange
- 5 mL sugar
- cup
- glass
- spoon
- filter paper
- funnel

Supplementary Resources

Household Science: Glen Hutton. Scarborough: Globe/Modern Curriculum Press, 1989.

Principles of Science: Book 2 Charles H. Heimler and Charles D. Neal. Ohio: Bell and Horvell Company, 1979.

Possible Media

- TV series *Wonderstruck*
- any TV cooking show

Evaluation

The student's mark in this module can be determined by their work in the Assignment Booklet. Each student must complete all assignments. In this module the student is expected to complete four section assignments. The assignment breakdown is as follows:

Section 1	=	30 marks
Section 2	=	22 marks
Section 3	=	25 marks
Section 4	=	23 marks
TOTAL	=	100 marks

Section 1: How Big Is It?

Measurements are continually being used in the home for household activities. Measuring is a scientific process. It is the intent of this section to make the student aware of the everyday measurements which actually constitute science in the home. Invite students to come up with unusual measurements which are made in the home.

Section 1: Activity 1

1. List some things that you have done in the past week that involve the use of length.

   - *driving (how much farther to go)*
   - *sewing*
   - *exercising (running, jogging, track and field)*
   - *buying clothes (clothing sizes: waist and leg)*
   - *measuring your height or foot (shoe size)*

2. What type of units were you using for describing length?

   mm (millimetre), m (metre), cm (centimetre), km (kilometre)

3. Using a metric ruler, metre stick, or metric tape measure, find the length of the following objects in and around your house. Use three different units (metre, centimetre, and millimetre) for each. Complete the following table with your measurements. For each measurement in the table, circle the unit that is most appropriate for each measurement.

Measurement	m	cm	mm
height of a doorway	*2.03 m*	*203 cm*	*2030 mm*
your height	*1.4 - 1.8 m*	*140 cm - 180 cm*	*14000 mm - 18000 mm*
length of a pencil	*0.10 - 0.20 m*	*10 - 20 cm*	*100 - 200 mm*
length of a vehicle	*4 m*	*400 cm*	*4000 mm*
width of piece of paper	*0.21 m*	*21 cm*	*210 mm*
width of your window	*1.22 m*	*122 cm*	*1220 mm*
length of your foot	*0.20 m +*	*20 cm +*	*200 mm +*
width of a picture frame	*(large variations)*		
length of a nail or pin	*0.05 - 0.10 m*	*5 - 10 cm*	*30 - 100 mm*
width of your bed	*1.32 m*	*132 cm*	*1320 mm*
width of your room	*3.7 m*	*370 cm*	*3700 mm*
length of your room	*3.0 m*	*300 cm*	*3000 mm*

All these answers are typical values. Your answers may vary somewhat, but make sure when you look at your answers that mm are 1000 × greater than m, and cm are 100 × greater than m.

4. a. Look at the measurement you made for the width of a window. Give an example when an accurate measurement of the width of the windows is required. Give an example when an estimation would be enough.

   accurate • *when getting a new window, curtains, or blinds*
   estimate • *when deciding how much paint to buy to repaint your room or windows*

   b. Give an example when an accurate measurement of the length of your foot is required. Give an example when an estimation would be enough.

   accurate • *when buying shoes*
   estimate • *when buying socks*

5. You want to help the family in resodding a patch of lawn that suffered severe winterkill. Find the area of the lawn which needs to be sodded, and state the number of square metres of sod which must be purchased to complete the job.

   $A = l \times w$
   $A = 4.5\ m \times 3\ m$
   $A = 13.5\ m^2$

   You would have to buy 14 m^2 of sod to resod the grass.

6. a. A blind is required for the master bedroom. Measure the window to determine size of blind that is required.

   You would require a blind that is 2 m × 1 m.

   b. If you wanted to purchase a bath mat, the bath mat must be less than ____*2*____ metres in length.

c. A new wall-to-wall carpet is required for the living room. What area of carpet is required?

Living Room Dimensions – length = 4 m
width = 2 m

$$\begin{aligned} A &= l \times w \\ &= 4\ m \times 2\ m \\ &= 8\ m^2 \end{aligned}$$

The living room requires 8 m^2 of carpet.

d. If you were to put wall paper on the livingroom wall labelled **W**, what area would you need to cover?

Wall Dimensions – length = 2.5 m
width = 2.0 m

$$\begin{aligned} A &= 2.5\ m \times 2.0\ m \\ &= 5.0\ m^2 \end{aligned}$$

*The living room wall labelled **W** would require 5.0 m^2 of wallpaper.*

e. You wish to purchase a new refrigerator. How tall can the refrigerator be?

Your new refrigerator could be 2 m tall.

Section 1: Activity 2

1. Make a list of things in your home or garage measured in litres or millilitres.

   The following are examples of things measured in litres or millilitres: milk, gas, motor oil, pop, juice, vanilla, syrup, cooking oil, liquid soap, window cleaner, vinegar, antifreeze, and windshield washer.

2. Were the cups that you chose close to the same volume? Could you use any of them for baking when an accurate measurement is required?

   You should have variation – some coffee cups are larger than others. You may find some cups that may be used for baking.

Investigation: Are You Getting What You Pay For?

3. Are there any drink brands that you would not buy because they are not giving the stated volume? Are there any that gave more?

   The difference from the volume stated was probably not great. The container is usually slightly larger than the stated volume.

4. As a consumer, is it important that you be able to measure and compare stated volumes with measured volumes? Explain.

   Yes, it's important to know how much of a product is in a container. Some packages are made larger but are not filled with the product.

5. a. Measure the length, width, and height of a 2 L milk carton. Measure only the straight part as indicated:

   length = 9.6 cm
   width = 9.6 cm
   height = 21.5 cm

   b. Calculate the volume, and compare this volume to the volume printed on the carton. Are the volumes the same?

   $V = l \times w \times h$
   $V = 9.6\ cm \times 9.6\ cm \times 21.5\ cm$
   $V = 1981\ cm^3$
   $(1000\ cm^3 = 1L)$

   The volumes are close to the same. The carton bulges on the sides when full, which allows for more milk to be put into the carton.

6. a. Find the volume of a sugar cube.

   $l = 1.5\ cm$
   $w = 1.5\ cm$
   $h = 1.5\ cm$

   $V = l \times w \times h$
   $V = 1.5\ cm \times 1.5\ cm \times 1.5\ cm$
   $V = 3.4\ cm^3$

b. How many sugar cubes would be needed if 15 mL of sugar are required?

$$\frac{15\ mL}{3.4\ mL\ /\ sugar\ cubes} = 4.4\ sugar\ cubes$$

You would need about $4\frac{1}{2}$ *sugar cubes to get a total of 15 mL.*

7. How much water is displaced after the walnut is added to the measuring cup?

   25 mL

8. Read each of the measuring cups to determine the volume of the substance or object that has been measured indirectly by displacement.

   a. *50 mL*
   b. *75 mL*
   c. *125 mL*

Section 1: Activity 3

1. a. Look around your house and garage and find ten things that are measured in grams, kilograms, milligrams, or tonnes. Write down the product with the measurement.

   - *sugar – 1 kg, 2 kg, 5 kg, 10 kg*
   - *flour – 10 kg*
   - *salt for water softener – 10 kg, 25 kg*
   - *chips – 1 kg, 500 g*
   - *medicines – 75 mg*
   - *cookies – 750 g*
   - *coffee – 2 kg, 500 g*
   - *tea – 1 kg, 500 g*
   - *raisins – 400 g*

   b. What is the most common unit of mass measurement?

   The gram (g) or kilogram (kg) are both common units of mass.

2. List the substances you measured from the smallest to the largest mass.

   cornflakes (smallest mass)
   rice
   water
   sugar (largest mass)

3. a. Of the two measurements, volume and mass, which do you think is the most useful? Explain.

      Knowing the mass of a substance may be better because the volume of a container may be deceptive due to its shape.

   b. Which would be easier to use if you wanted to estimate the amount of something?

      Volume may be easier to estimate because masses of different things of the same size may be very different.

4. Explain the difference between mass and volume and explain how understanding the difference could be important to you.

   Mass is the amount of matter, and volume is how much space something occupies. A product that takes up a great deal of space may not have much mass, so you should be careful when comparing the volumes of things. They may be very different in mass.

Section 1: Activity 4

1. Give the temperatures for

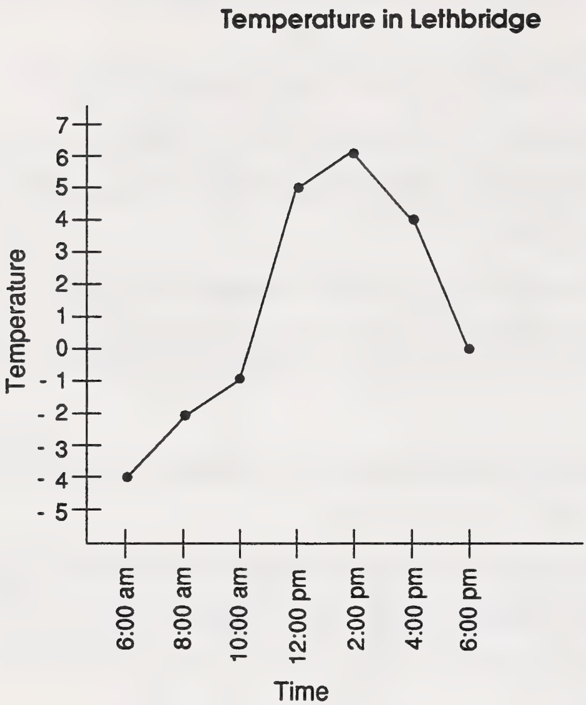
   a. boiling point of water *100° C*

   b. freezing point of water *0° C*

   c. pleasant room temperature *20° C - 22° C*

   d. your body temperature *37° C*

2. a. Now use your knowledge about graphing to make a graph of the following data for the outside temperature in Lethbridge for a 12 hour period.

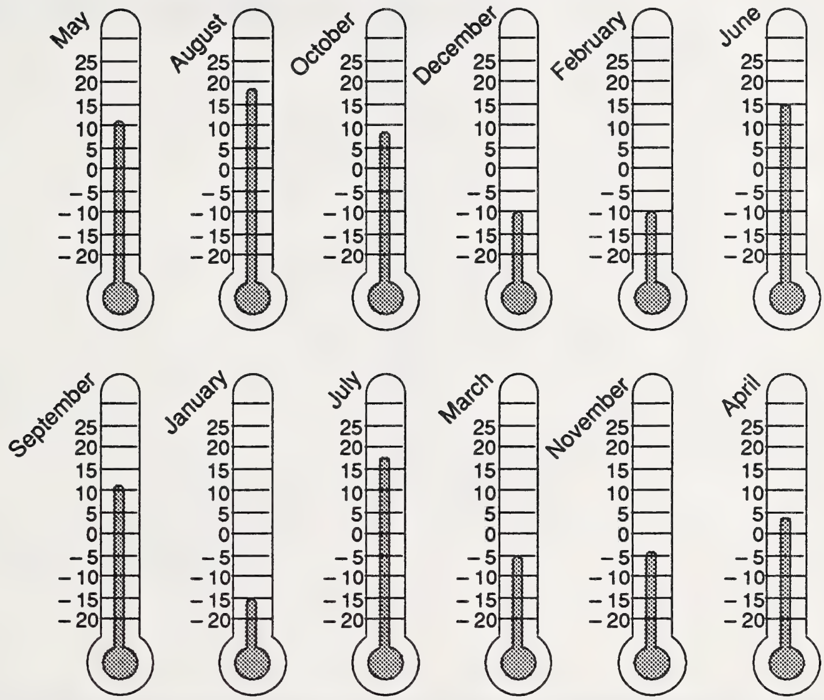


b. What trends do you see from the graph?

- *The temperature increases from 6:00 A.M. to 2:00 P.M.*
- *The temperature decreases from 2:00 P.M. to 6:00 P.M.*

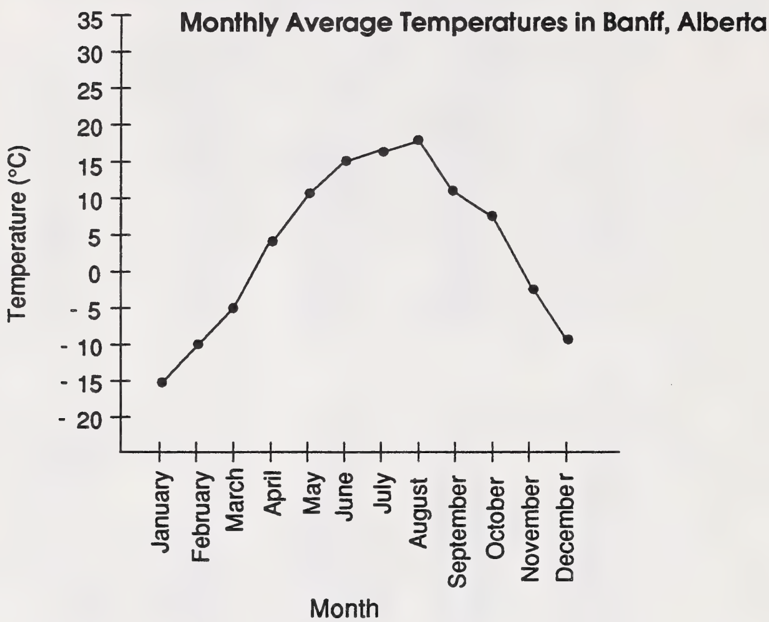
3. a. Read each thermometer and record the temperature beside the corresponding month in the data table.

Monthy Average Temperature in Banff, Alberta



Month	Temperature (°C)
January	*-15°C*
February	*-10°C*
March	*-5°C*
April	*4°C*
May	*11°C*
June	*15°C*
July	*17°C*
August	*18°C*
September	*11°C*
October	*8°C*
November	*-3°C*
December	*-10°C*

b. Plot the data from your data table on the following axes. Be sure that your graph is complete and correctly labelled.



c. Describe any trends on patterns that you see over the year for Banff, Alberta.

- *The average temperature rises from January to August.*
- *The average temperature decreases from August to January.*
- *The average monthly temperature is above zero from April to October.*
- *The average monthly temperature is below zero from November to March.*

Section 1: Follow-up Activities

Extra Help

12.

1. K I L O G R A M
2. E S T I M A T E
3. A R E A
4. M A S S
5. V O L U M E
6. L I T R E
7. G U E S S
8. K I L O M E T R E
9. C E L S I U S
10. D I S P L A C E M E N T
11. T H E R M O M E T E R

12. **Hidden Word** *measurement*

Enrichment

1. a. Were the measurements you recorded the same as the measurements the other person recorded? If not, why were they different?

   If you used feet or hands of about the same size, your measurements may be close, but if your foot or hand size differs much, your measurements would be different.

   b. Is using this technique for measurement reliable? Tell why or why not.

   It is not very reliable because everyone has different feet, arms, and hands.

   c. Give reasons why this way of measuring caused problems for the people who used it to buy and sell products.

   When people buy and sell products, they want to get a fair amount for the price. Using body units will mean that the amounts will vary depending on the size of the person doing the measuring.

Section 2: Mixing It Up

The kitchen provides the greatest variety of useful solutions. Other activities in the home that require solutions are bleaching clothes, painting, and maintaining automobiles and other mechanical devices. Invite the students to keep an eye open for other intriguing solutions found and used at home.

Section 2: Activity 1

1. List the homogeneous mixtures in the diagram.

   The homogeneous mixtures in the diagram are the coolaid and the pop.

2. List the heterogeneous mixtures in the diagram.

   The heterogeneous mixtures in the diagram are the mixed nuts, the tossed salad, and the salad dressing.

3. a. How would you separate a mixture of sand, salt, and water?

   To separate the mixture, first let the sand go to the bottom and pour off the salt water. Let the water evaporate and the salt will be left on the bottom as a solid.

   b. How could you separate out the parts in a serving of lettuce, carrots, and mushrooms?

   To separate out the parts of a salad, you would pick out the individual parts.

Section 2: Activity 2

1. Use the periodic table to write the symbol for each of the following elements.

   a. copper *Cu*
   b. oxygen *O*
   c. carbon *C*
   d. lead *Pb*
   e. calcium *Ca*

2. Write the name and symbols of two synthetic elements. The symbols for the synthetic elements are written in slanted letters on the periodic table.

   Any of the elements in this group are synthetic elements: #61, and 93-103.

3. a. From the following list of pure substances, decide which are elements and which are compounds, and put them in the correct column.

   Hint: Compounds will not be found on the periodic table of elements.

Elements	Compounds
silver	*carbon dioxide*
iron	*chalk*
mercury	*water*
gold	*alcohol*

   b. Add to this list by thinking of some other things around your house that may be either an element or a compound.

Elements	Compounds
Anything on the periodic table can be listed here.	*Make sure you list things that are not on the periodic table.*

Section 2: Activity 3

1. Identify the solute and solvent for each of the following solutions.

a.

Coffee

b.

c.

Air
Humidity 50%

Solution	Solute	Solvent
a. *coffee*	*coffee*	*water*
b. *oil and gas*	*oil*	*gas*
c. *water and air*	*water*	*air*

Investigation: Water – A Universal Solvent?

Substance Tested	Observations After Shaking for 1 Minute	Observations After Waiting for 2 Minutes
sugar	• *water dissolved most of the sugar* • *clear and colourless**	• *small amount of sugar on the bottom* • *clear and colourless solution*
salt	• *water dissolved most of the salt but water was cloudy*	• *still a bit cloudy* • *salt crystals at bottom of test tube*
cooking oil	• *oil was in little globs throughout the water*	• *oil has separated and gone to the top of the test tube*
powdered soap	• *most of the soap dissolved* • *bubbles at the top* • *cloudy solution*	• *clear solution* • *bubbles at the top* • *some powder has sunk to the bottom*
flour	• *some flour sticks to the bottom* • *bubbles on top; very white*	• *still cloudy* • *very little if any flour has dissolved*
butter	• *butter sticks to sides of test tube* • *breaks up into globs*	• *butter in globs in the water* • *no dissloving here*
baking soda	• *baking soda dissolves but makes a cloudy solution*	• *mostly a clear, colourless solution*
rubbing alcohol	• *mixes completely with water* • *colourless, some bubbles*	• *completely mixed* • *clear and colourless*
turpentine	• *cloudy mixture* • *globs of turpentine throughout water*	• *globs of turpentine throughout the water* • *most has risen to the top*
vinegar	• *mixes well* • *colourless solution*	• *completely mixed, clear, and colourless*
cornstarch	• *cloudy white mixture*	• *no mixing* • *still cloudy, cornstarch sunk to bottom*
instant coffee crystals	• *dark mixture* • *can't see through if too much coffee is dissolved*	• *dark solution* • *some undissolved*
drink crystals	• *mixes with water* • *some sinks to bottom, colour is colour of crystals*	• *coloured solution* • *most dissolved*

**colourless means no colour - clear means you can see through it*

2. a. Do all substances dissolve in water? That is, do all of the substances form water solutions? Explain using examples.

   No, many substances dissolve partially, like baking soda and coffee. Some do not dissolve at all, like oil, butter, turpentine, and cornstarch, so they don't form water solutions.

   b. Are solutions clear or cloudy mixtures?

   Solutions are clear (you can see through them), not cloudy.

3. Do the substances that dissolve in water dissolve in turpentine or alcohol?

   Some substances might, you will test this in Section 3.

4. Try to give a reason why different solutes dissolve in different solvents.

   The solutes and solvents must be similar types of substances to dissolve in each other.

Section 2: Follow-up Activities

Extra Help

1. Matter that has only one kind of atom is called an *element* .
2. Matter that has two or more different kinds of atoms chemically bonded together is called a *compound.*
3. Two or more different things blended together but not joined chemically are called a *mixture.*
4. A solution has *two* main parts.
5. The dissolved part of a solution is called the *solute.*
6. The part that does the dissolving in a solution is the *solvent.*
7. The most common solvent is *water*, and therefore it is sometimes called the *universal* solvent.
8. Solvents only dissolve certain things. This means solvents are *selective.*
9. *Matter* is what makes up everything around you.

10. Oil and water would be called a *heterogeneous* mixture because you can see separate parts, and salt water would be called a *homogeneous* mixture because no parts are visible.

11. Scientists organize information into groups. They *classify* matter into pure substances and mixtures.

12. One such organization is called the Periodic Table, which organizes all the *elements* into a table.

Enrichment

Investigation: Properties of Water in Solutions

Freezing Point of Water	*0°C or close to that*
Salt Solution Temperature	*lower than 0°C and lower than the temperature of the sugar solution*
Sugar Solution Temperature	*lower than 0°C but higher than the temperature of the salt solution*

1. What happens to the freezing point of water when a solute is dissolved in the water?

   The freezing point of water is decreased.

2. Does the addition of more sugar particles to the solution lower the freezing point?

   Yes, more sugar caused the freezing point to decrease.

Boiling Point of Water	*close to 100°C*
Boiling Point of Salt Water	*higher than 100°C*

3. What happens to the boiling point of water when salt is dissolved in the water?

   The boiling point of water increases when salt is added.

4. What do you predict would happen to the freezing point of water if any type of solute is dissolved in it?

   The freezing point will decrease.

5. Based upon what you have learned about the change in the properties of water when solutes are added, what is the benefit of adding antifreeze to the cooling system of a car in winter?

   The freezing point will decrease and the liquid solution will not freeze in very cold weather.

6. What do you predict would happen to the boiling point of water if any type of solute is dissolved in the water?

   The boiling point will increase.

7. How does the addition of antifreeze to the cooling system of a car help in the summer time?

   Antifreeze added to water increases the boiling point of the water so that the cooling system will not boil over in very hot weather.

Section 3: Solubility

Most people have learned a great deal about solubility without a scientific approach. Common sense, trial and error, and experience are often used by people in household activities dealing with solubility. This section uses a scientific perspective to examine solubility.

Section 3: Activity 1

1. a. Name two substances which are insoluble in water.

      The following substances are insoluble in water: oil, butter, cornstarch, and turpentine.

   b. Name two substances which are soluble in water.

      Some substances which are soluble in water are sugar, salt, alcohol, vinegar, drink crystals, and soap.

Investigation: Solutions and Dissolving – Other Solvents

Substances to Be Mixed solute – solvent	Observations After Shaking for 1 Minute	Observations After Waiting for 2 Minutes
oil – water	*globs of oil not dissolving*	*does not dissolve*
oil – turpentine	*oil dissolves*	*dissolved, clear*
butter – water	*small blobs but did not dissolve*	*does not dissolve*
butter – turpentine	*butter dissolves*	*dissolves*
sugar – water	*dissolves, clear*	*no further change*
sugar – rubbing alcohol	*nothing observed*	*no dissolving*
salt – rubbing alcohol	*nothing observed*	*no dissolving*
salt – water	*dissolves, clear*	*no change*
powdered soap – water	*solution formed*	*soap stays dissolved*
powdered soap – turpentine	*they mix and form bubbles*	*stays mixed*

2. Classify the substances you tested as soluble or insoluble in water. Write the names of the substances in the appropriate columns.

Soluble	**Insoluble**
oil - turpentine	*oil - water*
butter - turpentine	*butter - water*
sugar - water	*sugar - alcohol*
salt - water	*salt - alcohol*
powdered soap - water	
powdered soap - turpentine	

3. Were the substances that were insoluble in water soluble in other solvents? Use examples, to explain your answer.

   Some of the substances insoluble in water were soluble in other solvents. Oil was insoluble in water but it did dissolve in turpentine. Sugar and salt were soluble in water but not in alcohol.

4. Using what you learned from this investigation, explain why soap and water cleans oil-stained clothes better than water alone.

   Soap dissolves the oil and also dissolves in water so that the soap and grease solution can be washed away.

5. For each of the pictured examples try to predict what solute the solvent is dissolving.

Picture	Solvent	Solute
a. nail polish remover	trichloroethane	*fingernail polish*
b. suntan lotion	alcohol	*oils in the lotion*
c. iodine solution	alcohol	*iodine*
d. car wax	turpentine	*oils and waxes*
e. glue	water, alcohol, etc.	*gelatin*

6. List the rules for the safe handling of solvents.

   - *Use in a well-ventiliated area.*
   - *Keep away from sparks and flame.*
   - *Use gloves to protect flesh.*

Section 3: Activity 2

Investigation: Solubility of Solids and Temperature Effects

1. Did any more of the sugar dissolve after shaking for 1 minute? Explain.

   More sugar does dissolve (after shaking for 1 minute).
   Shaking seems to promote dissolving by making the dissolved solute evenly distributed.

2. Did more sugar dissolve when the water was heated?

   Yes, more sugar dissolved when the water was heated.

   Why do you think this happened?

   This is probably due to the greater randomness of the liquid and solid particles.

3. Make a general statement regarding the temperature of a solvent and the amount of solute that will dissolve.

   The higher the temperature, the more solute that will dissolve.

Investigation: Solubility of Gases and Temperature Effects

4. Predict what you think will happen to the solubility of a gas when the temperature of the solvent is increased or decreased?

   When the temperature of the solvent is increased, less gas can be dissolved.

5. When the Alka-Seltzer was dropped into the cold water, it fizzed because carbon dioxide gas was being produced. Some gas goes into the air. Where does the rest of the gas go?

   The rest of the gas that was produced went into the water (dissolved in the water).

6. What happened when you put the bottom of the test tube into the hot water?

   The solution started to bubble more and gas was given off.

7. Was the prediction that you made at the start of this investigation shown to be correct?

   If you predicted that less gas would dissolve in warm water you were correct. However, you may have thought that gases were the same as solids, which is not correct based on this investigation.

8. Make a general statement regarding the temperature of a solvent and the amount of gas that will dissolve.

   The higher temperature allows less gas to be dissolved. Lower temperature allows more gas to be dissolved in the solvent.

9. a. Would more solid dissolve in 100 mL of water at 25°C or 75°C?

      More solid would dissolve at 75°C.

   b. Would more gas dissolve in 100 mL of water at 25°C or 75°C?

      More gas would dissolve at 25°C.

Section 3: Activity 3

Investigation: How Much Will Dissolve?

1. Rate the solubility of each solid by placing descriptive words in the table (*most*, *least*, etc.).

Substance	Solubility
salt	*medium*
alum	*least*
sugar	*most*

2. Did all of each solid dissolve? Explain.

   Most of the sugar dissolved, about half of the salt dissolved, and only a little of the alum dissolved.

3. Were any of the solutions in this investigation saturated? Explain.

   All the solutions were saturated because no more of the solid was dissolving. (Some was left on the bottom.)

4. Predict what would happen if you heated each of the solutions.

   If you heated the solutions, more of the solid would dissolve.

5. Make a general statement about the solubility of solids in water.

   Solids all have different solubilities in water. Some solids dissolve well and others hardly dissolve at all.

Investigation: Making a Solution You Can Eat

6. As you stirred the solution, what happened? Describe what you saw.

   The supersaturated solution started turning solid again. As you stir the solid, it turns cloudy and finally almost white and creamy.

7. Describe the texture of the candy. Explain why the crystals are small.

   The candy texture is smooth. The crystals are small because they formed very quickly.

8. How do crystals of different sizes form?

   Different crystal sizes form depending on how long the supersaturated solution remains undisturbed. Small crystals form if the crystals are forced to form quickly. The longer the time to form, the larger the crystal size will be.

9. Why is a supersaturated solution unstable?

   A supersaturated solution is unstable because it is holding too many dissolved particles for that amount of solute at that temperature.

10. Explain the differences between unsaturated, saturated, and supersaturated solutions.

    Unsaturated solutions do not have as much solid dissolved as possible, more could dissolve. Saturated solutions have the maximun amount of solute dissolved and supersaturated solutions have more solute dissolved than there should be at that temperature.

Section 3: Follow-up Activities

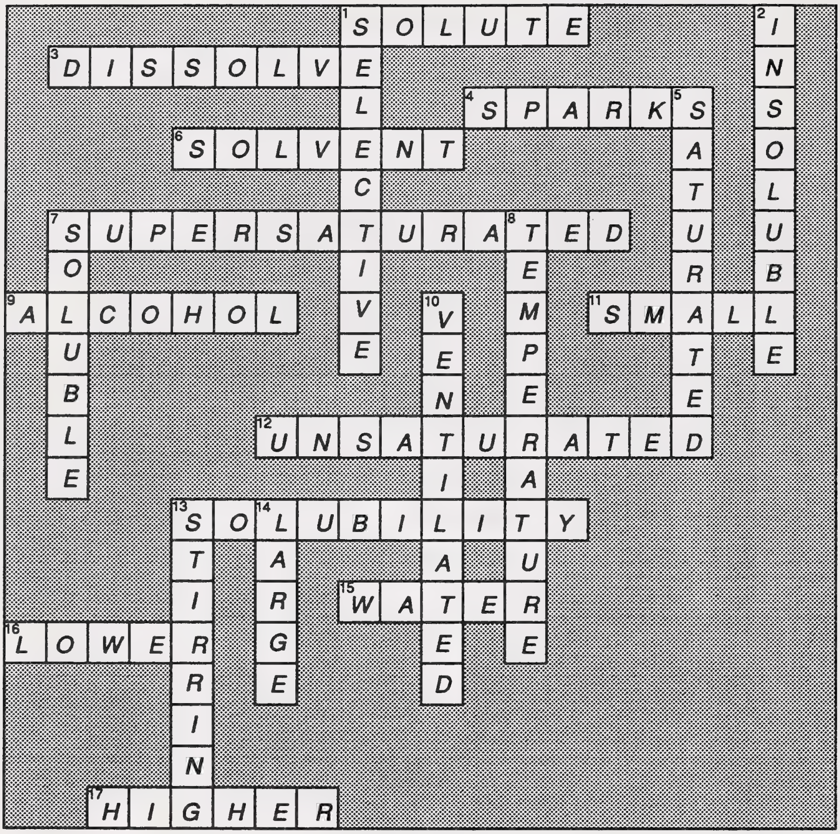
Extra Help

Across Clues

1. the part of a solution that dissolves
3. Sugar crystals will *dissolve* in water.
4. Solvents that can catch on fire should be kept away from *sparks*.
6. the part of a solution that particles dissolve in
7. when a solution holds more solute than it should at a certain temperature
9. a common solvent found in many lotions and hairsprays
11. *Small* crystals form quickly.
12. A solution is *unsatuarated* if the particles being added will still dissolve.
13. the ability of a substance to dissolve in a solvent
15. called the universal solvent
16. More gas can dissolve at a *lower* temperature.
17. More solid can dissolve at a *higher* temperature.

Down Clues

1. Solvents will dissolve only certain solutes. They are *selective*.
2. will not dissolve
5. when a solution has dissolved the most particles it can
7. will dissolve
8. one of the factors that influences solubility
10. use solvents in a well- *ventilated* area
13. will speed up dissolving
14. *Large* crystals form slowly.



Enrichment

1. The solution that you made is a supersaturated solution. Why do crystals form?

   Crystals form in the supersaturated solution because the solvent is holding too much solute and is therefore unstable. Crystals form because the extra solute cannot stay dissolved anymore and it recrystallizes.

Section 4: Suspensions

There are a large variety of household items which are suspensions. Producing suspensions is not often easily achieved. A variety of methods are investigated in this section. Students are encouraged to identify means of producing suspensions and also means of separating the components of suspensions.

Section 4: Activity 1

Investigation: Soil

1. Is the soil a pure substance or a mixture?

   Soil is a mixture. You should be able to see sand, organic particles, and a variety of other substances mixed together.

2. What do you think would happen if you added a small amount of water to the soil?

   The soil would turn into a muddy mixture.

3. What do you think would happen if you added a large amount of water to the soil?

   The water would dissolve the soluble parts of the soil, very light organic parts would float, the dense sand and clay would remain on the bottom, and the water would turn to a muddy colour.

4. After the soil and water is stirred, is the result a mixture, a suspension, or a solution?

   mixture

5. Explain your answer.

   The result is a mixture which should look like mud. The soil particles and water are mixed with little evidence of a suspension or a solution.

6. After the soil and water is well mixed, is the result a mixture, suspension, or a solution?

   suspension

7. Explain your answer.

   You can see the dark particles suspended in the water; light does not pass through the liquid.

8. Draw a diagram of the jar and its contents after it has been left for 30 minutes.

9. Describe the contents of the jar containing the filtered liquid.

   The water should be somewhat darker looking than clean water, but you should not be able to see any large particles suspended in the liquid.

10. Describe what is trapped in the filter.

    The filter should contain a mass of sediment and the material which floated on the water.

11. What are two ways you can remove the particles from a suspension?

    - *Let the heavier particles settle out on the bottom.*
    - *Filter the suspension to trap the larger particles and separate them from the liquid.*

12. Could you use either of the methods in #11 to remove the solute from a solution? Explain.

    No, you could not since the solute will not settle out of a solution nor can you filter the solute out of the solution.

Section 4: Activity 2

1. Classify the mixtures as either a suspension or a solution.

Mixture	Classification
a. house paint	*suspension*
b. shaving cream	*suspension*
c. ice cream	*suspension*
d. shampoo	*suspension*
e. antifreeze in your car	*solution*
f. tea	*solution*
g. baked cake	*suspension*
h. toothpaste	*suspension*
i. milk	*suspension*
j. butter	*suspension*

Investigation: Soap and Oil

2. What do you observe?

   The oil and water separate. The oil floats on the water.

3. What do you observe?

   The oil and water tend to mix when the soap is added.

4. What effect does the soap have on the oil and water mixture?

   Soap causes the oil to be suspended in the water.

Section 4: Follow-up Activities

Extra Help

A. emulsifier

B. solution

C. permanent suspension

D. temporary suspension

E. gel

D 1. particles settle out

E 2. Jell-O™

D 3. clay and water

B 4. particles dissolve fully

B 5. salt water

C 6. milk

C 7. particles remain suspended

C 8. smoke in the air

A 9. special substance that causes particles to remain suspended

B 10. soda pop

A 11. egg yolk

E 12. gelatin

D 13. freshly squeezed orange juice

A 14. soap

E 15. jelly-like permanent suspension

Enrichment

Investigation: Solution or Suspension?

1. What does the mixture look like?

   The mixture looks like a dark-coloured solution.

2. What is trapped in the filter paper?

   You might see some dark-coloured material trapped in the filter paper.

3. What has passed through the filter paper?

   A coffee-water solution has passed through the filter paper.

4. What does the mixture look like?

   The mixture looks like a clear solution.

5. What is trapped in the filter paper?

   Nothing is trapped in the filter paper.

6. What has passed through the filter paper?

   A sugar and water solution has passed through the filter paper.

7. What does the mixture look like?

   The mixture look like a light-coloured solution with tea leaves suspended and floating in it.

8. What is trapped in the filter paper?

   tea leaves

9. What has passed through the filter paper?

   A light-coloured solution has passed through the filter paper.

10. What does the mixture look like?

    an orange-coloured solution with particles suspended in it

11. What is trapped in the filter paper?

    Particles of orange fruit pulp are trapped in the filter paper.

12. What has passed through the filter paper?

    An orange-coloured solution has passed through the filter paper.

13. Which of the mixtures were solutions?

    The coffee and sugar mixtures are solutions.

14. Which of the mixtures were suspensions?

    Tea and orange juice are suspensions.

15. Does filtration work to separate all mixtures?

    No, filtration does not work to separate the solute and solvent in solutions. Filtration will only separate the suspended particles from a liquid or gas suspension. You might have correctly argued that tea and orange juice were also solutions because they were both a suspension and a solution.

Key to the Assignment Book

Section 1 Assignment (30 marks)

(2 marks) 1. Give an example of a situation where an estimated measurement could be used, and explain why you think an estimation is all that is necessary.

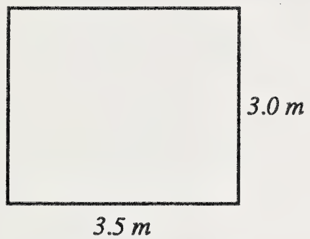
An estimated measurement can only be used when appropriate. Accurancy is not essential; e.g., a recipe calls for 5 mL of salt more or less to taste.

(2 marks) 2. Give an example of a situation where an accurate measurement must be made. Be sure to explain why accuracy is important for this measurement.

An accurate measurement must be made in order to achieve any objective. e.g., construction, buying and selling goods, sports events.

(3 marks) 3. a. You are planning to put new flooring in your bedroom. Draw a diagram of your bedroom's floor plan with the dimensions written on the diagram.

Answers will vary. The following is an example.



Lengths can be either in m or cm.

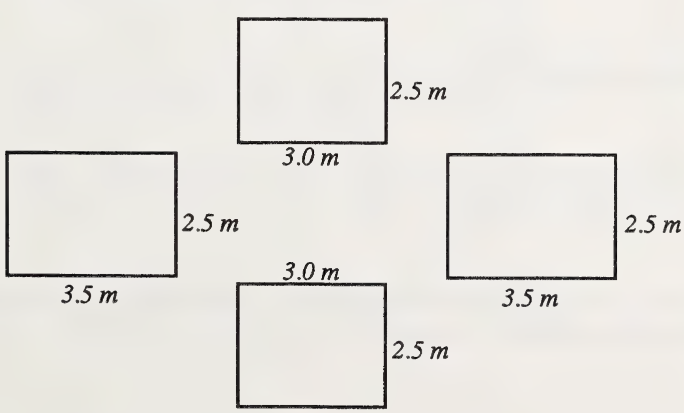
(1 mark) b. Calculate the area of your bedroom to see how much flooring is required. (If your bedroom is not a square or rectangle, break it up into squares or rectangles and add the pieces together.)

$$\begin{aligned} A &= l \times w \\ &= 3.5\ m \times 3.0\ m \\ &= 10.5\ m^2 \end{aligned}$$

The units can be m^2 or cm^2.

(4 marks) 4. a. You are planning to paint the walls in your bedroom. Draw a diagram of the walls with the dimensions written on the diagram.

Answers will vary. The following is a sample answer.



The units can be either m or cm.

(2 marks) b. Calculate the total area of the walls in your room.

$$\begin{aligned} A &= [2(l_1)+2(l_2)]h \\ &= [2(3.5\ m)+2(3\ m)]2.5\ m \\ &= [13.0\ m]2.5\ m \\ &= 32.5\ m^2 \end{aligned}$$

The units can be either m^2 or cm^2.

(2 marks) c. The paint you are buying covers 10 m^2 per litre. Based on the area of your walls, how many litres of paint will you need for your room?

$$\frac{32.5\ m^2}{10\ m^2\ / L} = 3.25\ L, \text{ therefore you need 4 L of paint.}$$

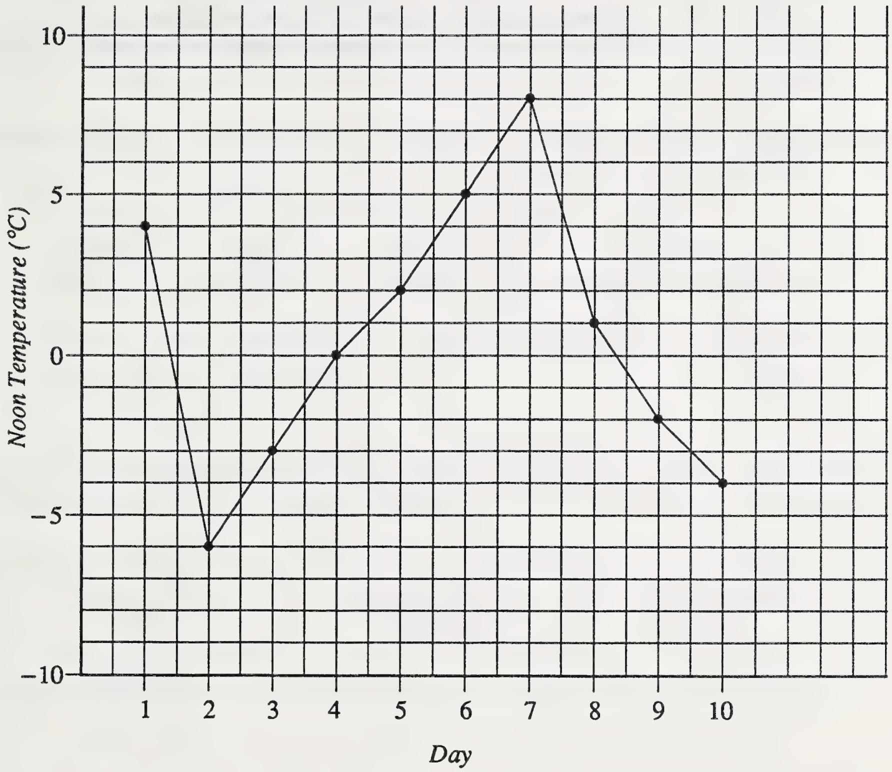
5. The following data shows the average noon temperature taken over a 10 day period in a small town in northern Alberta.

Table 1

Day	Noon Temperature
1	4°C
2	−6°C
3	−3°C
4	0°C
5	2°C
6	5°C
7	8°C
8	1°C
9	−2°C
10	−4°C

(6 marks) a. Draw a graph that represents the data from Table 1. Remember to use the guidelines for proper graphing techniques that can be found in Section 1: Activity 4.

Average Noon Temperature in Small Town, Alberta



To get full marks for this question the student should have plotted and joined all points correctly, labelled the axes, and given the graph a title.

(2 marks) b. From the information on your graph make a prediction on the temperature of day 11. Support your answer with information from the graph.

Answer should be about – 6 °C. The student should extrapolate the graph and make a statement regarding the unknown factors which affect the prediction.

(6 marks) 6. Use a measuring cup to determine the volume of three small, irregular-shaped objects. Fill the measuring cup about half full of water and record the volume. Add the object to be measured (if the object floats, push it down with a pencil until it is just under water), and record the new volume. Calculate the volume of the object by subtracting the initial volume from the final volume.

Complete Table 2 with your observations and calculations. Make sure you use the correct volume units for each measurement.

Object (Description or Diagram)	Initial Volume	Final Volume	Object Volume
Answers will vary depending on the object used. The following is a sample answer.			
e.g., eraser	*120 mL*	*125 mL*	*5 mL*

Section 2 Assignment (22 marks)

(6 marks) 1. For each mixture, state what substance is the solvent and what substance is the solute.

	solvent	solute
a. sea water	*water*	*salts*
b. soda pop	*water*	*sugar*, CO_2
c. brass	*copper*	*zinc*

(2 marks) 2. What is the essential difference between a solution and a mixture?

A solution has the solute uniformly distributed throughout and is molecular in size. A mixture may not be uniformly distributed and does not have to be molecular in size.

(2 marks) 3. Give an example of a mixture which is not a solution and explain why it is not a solution.

Accept any mixture which is not a solution. e.g., soil, sand, and salt

(2 marks) 4. Explain why a solution can never be considered a pure substance.

A pure substance is made up of only one kind of substance (element or compound). A solution has at least two kinds of substances.

(10 marks) 5. Indicate whether each of the following substances would form a solution if mixed with water. Place a checkmark in the appropriate column of the table given on the response page.

Substance	Yes – forms a solution	No – does not form a solution
a. cooking oil		✓
b. cornstarch		✓
c. sugar	✓	
d. turpentine		✓
e. juice or drink powder	✓	
f. bleach	✓	
g. vinegar	✓	
h. bacon fat		✓
i. soap		✓ *
j. gasoline	✓	

* *soap should form a suspension when mixed with water*

Section 3 Assignment (25 marks)

(3 marks) 1. Will the same amount of various substances dissolve in water at one temperature? For example, if 50 grams of sugar will dissolve in 200 mL of water at 10°C, will 50 grams of salt or any other substance dissolve in 200 mL of water at 10°C? Explain your answer.

No, the solubility of different substances is different. This is a different concept from varying solubility at different temperatures.

(2 marks) 2. If a substance is not soluble in water, will increasing the temperature of the water make it dissolve? Explain your answer.

No, in general the temperature has no effect on an insoluble substance. It should be noted that a student may explain that an insoluble substance at very low temperatures may be slightly soluble at very high temperatures.

(2 marks) 3. a. If you made two saturated solutions of sugar, solution A at 25°C and solution B at 75°C, which would contain more sugar? Explain your answer.

Solution B would contain more sugar, since more sugar dissolves at higher temperatures.

b. When solution B is cooled to 25°C with no sugar precipitating, what is that solution called? Why?

The solution is called supersaturated; since the solution was saturated at 75°C it must be supersaturated at 25°C.

(4 marks) 4. Why do the directions on a gelatin package tell you to add boiling water to the crystals and then add cold water after all the crystals have dissolved?

You have to dissolve all of the gelatin and sugar. It must be done in hot water and then cooled by using cold water afterwards.

(2 marks) 5. Turpentine is often used to clean paint brushes that have been used with oil paint because oil-based paints are soluble in turpentine. When would you not use turpentine to clean paint brushes?

You don't use turpentine to clean water-based paint. It won't dissolve.

(2 marks) 6. Since water is such a good solvent, why do the drains in your home get clogged?

The grease, fat, and other non-soluble materials collect in the pipe.

(4 marks) 7. Explain in detail the requirements of a good household drain cleaner. You are expected to discuss ideas not presented in this module such as: Where does it go and what effects will it have on pipes and the environment?

The drain cleaner

- *must dissolve the clog quickly*
- *must not emit harmful fumes*
- *must not corrode the pipes*
- *must not contain harmful poisons or other environmental poisons*
- *goes into the sewage system (and eventually back into the water cycle)*

(4 marks) 8. Suppose a black, sticky substance appears on the linoleum in your kitchen. Water won't remove it. Give two different methods you might try to remove the substance. For each method discuss the possible effects on the linoleum floor.

Method	Effect on Linoleum
detergents	*should not harm the floor*
non-polar solvents such as turpentine, paint thinner, etc.	*might dissolve the flooring*

(2 marks) 9. Many plastic pipe products are effectively joined by using a special solvent. The solvent is applied to the parts to be joined. Then the plastic parts are pushed together. In about 10 seconds the plastic is firmly and permanently joined. Using your knowledge of solutions, explain how this process works.

The solvent dissolves the outside of the plastic pipe, allowing the liquid plastic to mix when the two the parts are pushed together. The solvent evaporates, fusing the two plastic pieces together. (This is not a melting process.)

Section 4 Assignment (23 marks)

(6 marks) 1. Compare liquid solutions and liquid suspensions by completing the table on the response page.

	Clear or Cloudy?	Can you see particles?	Do particles settle out?
Solution	*clear*	*no*	*no*
Suspension	*cloudy*	*yes*	*maybe*

(2 marks) 2. What is the advantage of having permanent suspensions as opposed to temporary suspensions for food, medicine, and other household items?

Permanent suspensions do not require shaking or mixing before use. In the case of medicine, temporary suspensions are risky in case the patient fails to shake the medicine prior to taking it.

(2 marks) 3. How can temporary suspensions be made permanent? Explain this by using examples.

- *Use mechanical methods to make the particles too small to settle out.*
- *Use emulsifiers such as soap, egg yolk, etc.*

4. Perform the following investigation in which you will test various household materials to see whether they form mixtures or solutions.

Select five household substances that are different from the ones used in Sections 2 and 3. Try to pick your own substances. If you can't think of enough, try aspirin, vitamins, food colouring, various cleaners, and various food items.

(3 marks) a. Explain the steps you will take to test the solubility of your chosen substances.

- *place water and substance in a cup or test tube*
- *mix with a spoon or shake well*
- shine a light on the mixture (clear or cloudy)
- *let the mixture sit to see if anything settles out*
- *filter to see if anything can be filtered out*

(5 marks) b. Record your observations in the table. Use terms such as *clear*, *cloudy*, and *settled out*. Give specific colours, if any.

Substance	Observations
aspirin	*dissolves completely after 1 minute of mixing*
	Answers will vary.

(5 marks) c. Classify each mixture as *solution*, *suspension*, or *does not mix.*

Substance	Classification
aspirin	*solution*
	Answers will vary.

This booklet cannot be purchased separately; the Learning Facilitator's Manual is available only as a complete set.

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